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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	SMALL, Robert J., et al.	Confirmation No:	1633
Serial No.:	10/683,730	Art Unit:	2812
Filed:	October 10, 2003	Examiner:	Quoc Dinh HOANG
For:	**CHEMICAL MECHANICAL POLISHING COMPOSITION AND PROCESS**	Attorney Docket No:	060937-0211

APPELLANT'S BRIEF UNDER 37 C.F.R. § 1.192

This brief is in furtherance of the Notice of Appeal, filed in the above-identified patent application on May 10, 2005, which included a Petition of Extension of Time and fee concurrently filed therewith.

1. THE REAL PARTY IN INTEREST

The real party in interest in this appeal is DuPont Air Products Nanomaterials LLC ("DANanomaterials"), a joint venture between E.I. duPont de Nemours and Company and Air Products Inc. The application is on record as being assigned to EKC Technology, Inc., but rights to the pending application were transferred to DANanomaterials in 2004.

2. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any other appeals or interferences that will directly affect, or be directly affected by, or have a bearing on the Board's decision in the appeal. The Board is invited to review the file of OBENG v. SMALL, Interference No. 104,640, which resulted in the issuing of U.S. Patent 6,635,186. U.S. Patent 6,635,186 has a common specification as the instant application, and issued claim 1 which reads: "A method of polishing a material comprising: exposing said material to a slurry which contains an abrasive and an organic oxidant being hydroxylamine." A number of pending dependent claims which stand rejected over the cited art recite hydroxylamine. However, Applicants believe the issues are very clear, and the Board will likely resolve the issues without resorting to the above-mentioned file.

3. STATUS OF CLAIMS IN APPLICATION

The status of the claims is as follows:

Claims canceled: 1-6 and 24-49
Claims pending: 7-23 and 50-62
Claims allowed: none.
Claims rejected: 7-23 and 50-62
Claims withdrawn: none.

The claims on appeal are claims 7-13, 15-23 and 50-62 which stand rejected under 35 U.S.C. 102 or alternatively 35 U.S.C. 103 as being unpatentable over U.S. Pat. 5,993,686. The only independent is claim 7. The rejection of Claim 14 is not being appealed.

4. STATUS OF AMENDMENTS

Appellant's representative conducted an interview with the Examiner on April 1, 2005, and subsequently filed an Amendment After Final Rejection on April 11, 2005 (the Monday after the Due Date). The Amendment After Final Rejection amended claim 7, canceled claim 62 and added claims 63 and 64. Appellant received an Advisory Action mailed April 19, 2005 which stated the amendment would not be entered because the amendment after final raised new issues and because it presented additional claims without canceling a corresponding number of finally rejected claims.

5. SUMMARY OF THE INVENTION

Claim 7 recites a method of chemically mechanically polishing a metal on a substrate with a polishing slurry comprising the first and second oxidizers that exhibits a synergistically increased substrate metal removal rate.

Appellant's present invention relates to the use of certain compositions to polish and planarize the metal disposed on the surface of semiconductor substrates during the manufacturing process in a process step called chemical mechanical polishing. *See* page 1, lines 9-10. Chemical mechanical polishing slurries typically have an abrasive, water, and an oxidizer. *See* page 3, lines 14-17. Typical oxidizers are hydroxylamine, ammonium persulfate, hydrogen peroxide, peracetic acid, and periodic acid. *See* page 6, line 27 to page 7, line 7. Generally, the slurries work by first having the oxidizer oxidize a top layer of metal, and subsequently the abrasives remove the oxidized layer. *See* page 3, lines 23-29. This action planarizes the surface, because while the thin layer of metal oxide formed over the metal is easy to abrade away, a layer of metal oxide in depressions on the substrate does not get abraded away, and it eventually forms a passivating oxide layer which remains until it is eventually abraded away. *See, e.g.,* page 4, lines 1-6. Chemical mechanical polishing is therefore a balanced process where corrosion (oxidation of metal) and abrasion occur simultaneously. Abrasion alone is too slow a process, and corrosion alone would not planarize a surface. *See, e.g.,* page 3, line 29 to page 4, line 2.

Appellants first mentioned the possibility of using more than one oxidizer on page 16, lines 3-5. Appellants noted peroxymonosulfuric acid (Caro's acid) was useful with ammonium persulfate on page 18, lines 4-5. Appellants invention was the realization that synergistic removal rates were obtained when certain combinations of oxidizers were both present in the slurry. *See*, e.g., page 18, line 21 for synergy with Caro's acid and ammonium persulfate. *See* page 21, lines 6-8 for a statement of the general principal of synergy and for the combination of hydrogen peroxide and hydroxylamine.

Reasons for obtaining synergy are not totally clear. In certain instances, certain combinations of oxidizers will react one with another and will self-destruct, and there will be no synergy. In other instances, the more powerful oxidizer which is usually primarily responsible for oxidizing the metal is partially consumed by reacting with (and oxidizing) the weaker oxidizer. The only apparent mechanisms by which synergistic metal removal can be explained are 1) if the weaker oxidizer (with a lower electronegative potential) is rejuvenated by the interaction with (and destruction of) the more powerful oxidant, coupled with the fact that the weaker oxidizer is for some reason more reactive with the substrate surface than is the stronger oxidizer; or 2) the two oxidizers react to form a super-oxidizer such as an hydroxyl radical. Applicants unexpectedly found a number of combinations of oxidizers that provided synergistically increased metal removal rates.

The various slurries can comprise one or more common adjuvants, such as fluoride (*see* page 14, line 26), pH adjustors(*see* page 7, lines 24-25), chelators (*see* page 11, line 30), corrosion inhibitors(*see* page 12, lines 16-18), surfactants (*see* page 13, line 29), and the like. There were three "limitations by argument" presented by Applicants arguments made in amendments during prosecution, each of which was submitted proactively and not as a result of any rejections over prior art, but rather in trying to explain the bounds of the invention. These "limitations by arguments" include: (1) that the first and second oxidizers were different and the second oxidizer not merely a reaction product of the first oxidizer; (2) that nitric acid is not a first or second oxidizer as contemplated in claim 7, and (3) that fluoride species are not a first or second oxidizer as contemplated in claim 7.

The first and second oxidizers recited in claim 7 are different species and the second oxidizer not merely a reaction product of the first oxidizer. Applicants believe this limitation is implicit in the recitation of first and second oxidizers, and point the Boards attention to the first full paragraph on page 21 of the specification, which states "In accordance with a further aspect of this invention, another unique idea is to blend two different chemistries to achieve synergistic interactions." Appellants mentioned this merely to put this position into the record, as it is well known that the byproducts of the reaction of certain oxidizers such as periodic acid upon oxidizing a substrate are themselves oxidizers.

Nitric acid is not an "oxidizer" as the term is used in claim 7. Claim 62 was added to try to make that limitation explicit. At the time the application was filed, neither the Applicants nor one of ordinary skill in the art would consider nitric acid to be an "oxidizer", as the term was used in the context of chemical mechanical polishing slurries reciting a synergistic combination of two oxidizers. Applicants wanted this to be clear because the specification on page 4 lines 12-15, in describing some problems with prior art polishing formulations, mentioned that nitric acid was being used as an oxidizer. Nitric acid is such a weak oxidizer it has substantially no effect on many metals, and any effects it may have are likely pH effects. Generally, nitric acid is not considered an oxidizer by one of ordinary skill in the art, especially if it is present in a slurry which contains a traditional oxidizer. Applicants specifically disclaim nitric acid as being an oxidizer as the term is used in claim 7 *et seq.*

Finally, Appellants would like to restate here arguments extensively and proactively made in the Amendment filed on October 14, 2004 that fluoride is not an "oxidizer" as the term is used in claim 7. No rejection was proposed by the Examiner that used a fluoride-containing substance as an oxidizer. At the time the application was filed, the Applicants and one of ordinary skill in the art would not consider a fluoride-containing compound such as ammonium bifluoride to be an "oxidizer" as the term was used in the context of chemical mechanical polishing slurries of claim 7.

The broadest concept of the invention was a polishing slurry comprising an oxidizing agent, as recited in the first paragraph under the Summary Of The Invention (on page 7 in the original specification). Representative oxidizers are repeatedly recited in the specification. *See* for example the second through the fifth paragraphs under the Summary Of The Invention (on pages 7 to 8 in the original specification) reciting hydroxylamine, ammonium persulfate, a compound which is an indirect source of hydrogen peroxide, peracetic acid, and periodic acid, respectively. Other oxidizers mentioned in the Summary of the invention, the Detailed description, and/or in the Examples included ferric nitrate (*see* page 20, lines 5-7), a salt of hydroxylamine (*see* page 9, lines 23-25), hydrogen peroxide (*see* page 20, lines 18-19 and page 21, lines 6-8), urea hydrogen peroxide(*see* page 20, lines 13-15), a percarbonate (*see* page 19, line 29), a perborate (*see* page 19, line 19), ammonium peroxydisulfate (*see* page 28, lines 29-30), and peroxymonosulfate (*see* page 18, lines 4-23). Fluoride is not listed as an oxidant.

The application mentions using ammonium bifluoride in the context of oxide polishing. S*ee* the paragraph bridging pages 14 and 15. Oxide polishing, which means polishing an oxide layer such as silica (*see* page 14, first full paragraph), is distinguished from metal polishing wherein the polishing is enhanced by an oxidizer reacting with the metal to form a layer of metal oxide which is then removed (*see* page 3, last two paragraphs). In the context of oxide polishing, the application discusses why it is advantageous to not have an oxidizing slurry. *See* page 15, first and second full paragraphs. It is therefore clear that Applicants did not intend a fluoride-containing compound to be classified as an oxidizer, either in the specification itself nor in claim 7, and Applicants specifically disclaim any fluoride as being an oxidizer as the term is used in claim 7 *et seq*.

Claim 8 recites the slurry comprise an abrasive. *See* original claim 1 on page 33. Note in some fabrication shops, the abrasive is on the polishing pad.

Claim 9 recites polyelectrolyte in an amount sufficient to encourage the abrasive particles to repel one another. *See generally* page 13, lines 6-11 and 29-30, *and specifically* page 15 line 30 to page 16 line 1.

Claim 10 recites polyelectrolyte in an amount sufficient to encourage the abrasive particles to repel the surface to be polished. This is a different amount than is needed to simply stabilize a slurry by making abrasive particles repel one another as recited in claim 9. *See generally* page 13, lines 6-10 and 20-22, *and specifically* page 15 line 30 to page 16 line 1.

Claim 11 recites the combination of ammonium persulfate and a peroxymonosulfate compound. *See* page 18, lines 4-5 and page 18, line 21.

Claim 12 recites the combination of hydroxylamine nitrate and hydroxylamine. Use of hydroxylamine and hydroxylamine nitrate is described on page 27, lines 18-22, and the data at page 28, lines 1-4.

Claim 13 recites that one oxidizer is hydroxylamine nitrate present at 0.5% to about 10%. *See* page 16 lines 3-5, page 27 lines 18-22, and the data at page 28 lines 1-4. *See* page 13, lines 23-28, for support for the range of 1% to 10%. An example having 10% (for tungsten) can be found at page 27 lines 20-21. A polishing-only example having 0.5% (for copper) can be found at page 31 lines 25-26.

Claim 14 recites the first oxidizer comprises from about 2% to about 10% hydroxylamine nitrate. Applicants believe this was a typographical error that should have recited a range of 1% to 10% as described on page 13 lines 23-28. This claim is not being appealed.

Claim 15 recites that one oxidizer is hydroxylamine present at 1% to about 10%. *See* page 13 lines 23-28.

Claim 16 recites that one oxidizer is hydroxylamine nitrate and the other oxidizer is from about 0.005% to about 0.36% by weight hydroxylamine. Applicants have previously shown, *e.g.,* in the Remarks section of the amendment filed October 10, 2003, that one of ordinary skill in the art would know that a composition containing 24 parts of 82% by weight hydroxylamine nitrate in 176 parts of deionized water as described on page 27 lines 20-24 would require the following amount of hydroxylamine to attain the pH values reported in the Table at page 28, lines 1-4: a pH of 3 requires 0.005% hydroxylamine, a pH of 4 requires 0.04% hydroxylamine, and a pH of 5 requires 0.36% hydroxylamine.

Claim 17 recites that one oxidizer is hydroxylamine nitrate and the other oxidizer is from about 0.04% by weight hydroxylamine. *See* above discussion relating to claim 16.

Claim 18 recites that one oxidizer is ammonium persulfate and the other oxidizer is from about 0.5% to about 2% periodic acid. *See* page 22, lines 9-11 for the combination of ammonium persulfate and periodic acid. *See* data on page 23, lines 6-13, for the recited range of periodic acid.

Claim 19 recites one oxidizer is hydrogen peroxide and the other oxidizer comprises hydroxylamine. *See* page 21, lines 6-8.

Claim 20 recites one oxidizer is hydrogen peroxide and the other oxidizer comprises from about 1% to about 10% hydroxylamine. *See* page 21 lines 6-8 and page 13 lines 23-28.

Claim 21 recites one oxidizer is ammonium persulfate and the other oxidizer potassium periodate. *See* page 21, lines 25-27.

Claim 22 recites one oxidizer is ammonium persulfate and the other oxidizer is potassium iodate. *See, e.g.,* page 24 line 28 to page 25 line 10.

Claim 23 recites one oxidizer is ammonium persulfate and the other oxidizer is periodic acid. *See* page 22, lines 9-11.

Claims 50, 51, and 52 recite the polishing slurry comprises about 0.005%, 0.04%, and 0.36% by weight hydroxylamine. Applicants have previously shown, *e.g.,* in the Remarks section of the amendment filed October 10, 2003, that one of ordinary skill in the art would know that a composition containing 24 parts of 82% by weight hydroxylamine nitrate in 176 parts of deionized water as described on page 27 lines 20-24 would require the following amount of hydroxylamine to attain the pH values reported in the Table at page 28, lines 1-4: a pH of 3 requires 0.005% hydroxylamine, a pH of 4 requires 0.04% hydroxylamine, and a pH of 5 requires 0.36% hydroxylamine.

Claim 53 recites one oxidizer is an indirect source of hydrogen peroxide. *See* page 21 lines 6-8 and page 8 lines 1-3. **Claim 54** recites one oxidizer is an urea hydrogen peroxide complex. *See* page 21 lines 6-8 and page 20 lines 13-15. **Claim 55** recites one oxidizer is a percarbonate. *See* page 21 lines 6-8 and page 19 lines 29-31. **Claim 56** recites one oxidizer is an indirect source of hydrogen peroxide and the other oxidizer is hydroxylamine. *See* page 21 lines 6-8 and page 8 lines 1-3.

Claim 57 recites one oxidizer is a persulfate and the other oxidizer is an IO_3^- salt. *See, e.g.,* page 24 line 28 to page 25 line 14.

Claim 58 recites one oxidizer is a persulfate and the other oxidizer is an IO_4^- salt. *See* page 24 line 27 and page 26 lines 12-14.

Claim 59 recites one oxidizer is a persulfate and the other oxidizer is a $H_4IO_6^{-2}$ salt. *See* page 21, lines 25-27.

Claim 60 recites at least one oxidizer is selected to not contribute to mobile ion contamination. An important feature of slurries used in semiconductor manufacture is that they do not contribute to mobile ion contamination of the substrate. *See* page 4, lines 18-19. While that text was written in 1998, it is far more important these days as integrated circuits are continually reduced in size. *See* page 6, lines 23-25, and also page 11, lines 28-29.

Claim 61 recites that the slurry does not stain polishing equipment. *See* page 4, lines 18-20.

Claim 62 recites that neither the first nor the second oxidizers in the slurry are nitric acid. See page 4 lines 12-17 and 23-24. At the time the application was filed that one of ordinary skill in the art would not consider nitric acid to be an "oxidizer" as the term was used in the context of chemical mechanical polishing slurries of claim 7. Generally, nitric acid is not considered an oxidizer by one of ordinary skill in the art, and especially so if it is present in a slurry of other oxidizers. Nitric acid is such a weak oxidizer it has substantially no effect on many metals, and any effects are likely pH effects.

6. ISSUE

The following issues are presented on appeal: Whether Claims 7-13, 19, 21-23 and 53-62 are unpatentable as being anticipated by U.S. Pat. 5,993,686, and whether Claims 15-18, 20, and 50-52 are unpatentable as being obvious over U.S. Pat. 5,993,686.

7. GROUPING OF CLAIMS

The invention encompasses a number of combinations, and therefore do not stand together. For the convenience of the Board, groups of claims that stand or fall together are listed below.

Claim 7-9 stand or fall together.
Claim 10 stands or falls alone.
Claim 11 stands or falls alone.
Claims 12 stands or falls alone.
Claim 13 stands or falls alone.
Claim 14 is not appealed.
Claim 15 stands or falls alone.
Claims 16-17 stand or fall together.
Claims 18 and 23 stand or fall together.
Claims 19-20 stand or fall together.

Claims 21 and 58 stand or fall together.

Claim 22 and 57 stand or fall together.

Claims 50-52 stand or fall together.

Claims 53 stands or falls alone.

Claim 54 stands or falls alone.

Claim 55 stands or falls alone.

Claim 56 stands or falls alone.

Claim 59 stands or falls alone.

Claim 60 stands or falls alone.

Claim 61 stands or falls alone.

Claim 62 stands or falls alone.

8. ARGUMENTS

Rejections under 35 U.S.C. 102

Most of the following claims stand as being rejected under 35 U.S.C. 102 over Streinz. A few claims argued below stand as being rejected under 35 U.S.C. 103 over Streinz. These latter claims are included in this section only if they stand or fall with a claim that the Examiner contends is anticipated by Streinz.

A. With respect to Claims 7-9

Claims 7-9 stands rejected as being anticipated by Steintz. Claim 7 recites a slurry having two oxidizers that exhibits a synergistically increased metal removal rate.

Streinz describes "a chemical mechanical polishing slurry comprising an abrasive, an oxidizing agent, and a fluoride containing additive." *See* Streinz, column 3, lines 20-23. Streinz at column 2 lines 45-51 states

> "the oxidizing agent useful in the chemical mechanical polishing slurry is incorporated into a CMP slurry to aid in oxidizing a metal layer to its corresponding oxide or ions. For example, in the present invention, an oxidizing agent may be used to oxidize a metal layer to its corresponding oxide--titanium to titanium oxide, tungsten to tungsten oxide, and copper to copper oxide for example."

Streinz subsequently in the paragraph bridging columns 2 and 3 discloses a laundry list reciting almost every known oxidizer, and merely adds "and mixtures thereof" at the end of the "laundry list" of oxidizers, as quoted below:

> Suitable oxidizing agents are those that are compatible with fluoride containing additives including oxidizing metal salts, oxidizing metal complexes, nonmetallic oxidizing acids such as peracetic and periodic acids, iron salts such as nitrates, sulfates, EDTA, citrates, potassium ferricyanide, hydrogen peroxide, potassium dichromate, potassium iodate, potassium bromate, vanadium trioxide and the like, aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof.

See Streinz, column 3, line 59 to column 4, line 4 (*Emphasis added*).

The Examiner relies on this disclosure for the rejection of all claims. Claim 7 recites "a polishing slurry comprising a first oxidizer and a second oxidizer, wherein the second oxidizer is different than the first oxidizer, and the slurry comprising the first and second oxidizers exhibits a synergistically increased substrate removal rate." Applicants maintain that the phrase "and mixtures thereof" on the end of a laundry list of oxidizers does not anticipate claim 7. There is no teaching or suggestion in Streinz, as required by claim 7, of any synergistically increased metal removal rate which will be obtained by providing combinations of oxidizers.

Appellants concede that a patent is good for all it teaches, and that evidence of secondary considerations such as unexpected results is irrelevant to 35 U.S.C. 102 rejections. Nevertheless, Applicants maintain that the broad disclosure of Streinz does not qualify as an anticipatory document. Streinz does not teach that a combination of two oxidizers may give synergy with metal removal rates. Indeed, Streinz does not fairly teach combining any of the combinations of oxidizers for which Applicants found the synergy in metal removal rates. This is because Appellants and the Examiner disagree about what the phrase "and mixtures thereof" in at column 4 line 4 of Streinz refers to. The punctuation (or lack thereof), and use of the phrase "such as" at column 3 line 62 and more importantly the inclusion of the phrase "and the like" at column 3 line 67 requires that the list in the disclosure of Streinz should be construed as follows:

> Suitable oxidizing agents are those that are compatible with fluoride containing additives including
>
> a) oxidizing metal salts,
> b) oxidizing metal complexes,
> c) nonmetallic oxidizing acids such as peracetic and periodic acids,
> d) iron salts such as nitrates, sulfates, EDTA, citrates, (and) potassium ferricyanide,
> e) hydrogen peroxide,
> f) potassium dichromate,
> g) potassium iodate,

> h) potassium bromate,
> i) vanadium trioxide and the like, (and)
> j) aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof.

The disclosure must be read for what it might teach, and the Examiner can not ignore punctuation (or lack thereof) to make the disclosure say more than it says. The list clearly groups oxidizers, as shown by the inclusion of oxidizing metal complexes group, followed by nonmetallic oxidizing acids group, then the iron salts group, then hydrogen peroxide.... The use of the term "and the like" in part (i) is a clear delimiter in the list. Further, the terms "sodium salts" potassium salts" and ammonium salts are nonsensical (they don't oxidize" unless they refer to the "peroxides, perchlorates..." at the end of this group. Finally, as there is no comma between "persulfates" and the phrase "and mixtures thereof", the disclosure must be construed to recite a last group which reads "aluminum salts ... or other cationic salts of peroxides, perchlorates ... or mixtures thereof." That is, the phrase "and mixtures thereof" must refer to the group of salts of oxidizers which begins with "aluminum salts" and ends with "and mixtures thereof." Therefore, the phrase "and mixtures thereof" in Streinz can not refer back to the "nonmetallic oxidizing acids such as peracetic and periodic acids." Reading the phrase "and mixtures thereof" to refer back to "nonmetallic oxidizing acids such as peracetic and periodic acids" would require ignoring the phrase "and the like", as well as adding punctuation (new matter) not present in the disclosure.

Applicants note that the claims of Streinz recites a different list than is in the disclosure, in particular eliminating the term "and the like" and changing the last lines to read "sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, cationic salts of peroxides, cationic,*(er)* salts of chlorates, cationic salts of perchlorates, cationic salts of nitrates, cationic salts of permanganates, cationic salts of persulfates and mixtures thereof. Here, it is not even clear if the term "ammonium salts" refers to any ammonium salt (as if ammonium were an oxidizer) or to ammonium salts of peroxides. It is also not know if the pertinent language in these claims was submitted to the Patent Office prior to Appellant's filing date. However, to the extent the claims contain new matter not in the specification as originally filed, it is not certain whether the claims of Streinz constitute prior art to the instant application.

Applicants surprisingly found that certain combinations of oxidizers gave synergy in metal removal rates. But none of these groups fall with the group "aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof." Applicants therefore respectfully ask that the rejection of claim 7 as being anticipated by Streinz be withdrawn.

Applicants further contend that Streinz did not accidentally anticipate the claims. Although not mentioned or relied on by the Examiner, Streinz teaches a combination of an oxidizer and a fluoride-containing additive. However, like Appellants with regard to claim 7, neither Streinz nor one of ordinary skill in the art at the time the application was filed would consider the fluoride-containing additive to be an oxidizer. Fluoride species were not included in the laundry list of oxidizers. Streinz has claims to a slurry having an oxidizer and having a "fluoride containing additive." Strienz teaches "the fluoride component of the fluoride containing additive causes titanium to form a hydrated oxide layer that is more easily abraded than the oxide layer formed in the absence of fluoride." *See* Streinz, column 4, lines 18-23. Streinz teaches that the concentration of oxidizers is 0.5% to 15%, preferably 1% to 7%. *See* Streinz, column 4, lines 8-13. In contrast, Steintz teaches that the fluoride-containing additive concentration is 0.01% to 2%, preferably 0.01% to 1%. *See* Streinz, column 4, line 61 to column 5, line 5. *See also* Strienz, column 3, lines 1-4; column 5, lines 25-29; column 8, lines 24-29; column 8, lines 53-56; and claim 1 for further text showing Streinz did not intend that the fluoride-containing agent to be considered an oxidizer. Further, Steintz's interpretation of oxidizer is the same as Appellant's intended meaning of the term oxidizer.

Streinz teaches using an oxidizer with a fluoride-containing additive. Streinz does not teach any combination of first and second oxidizers that provide a synergistic metal removal rate. There is no mention of synergy using any combinations of oxidizers in Streinz. There are no examples in Streinz that use a plurality of oxidizers, nor any teaching as to what combinations may be beneficial. The term "and mixtures thereof" ending Streinz's list of essentially all oxidizers does not anticipate Applicant's claimed invention that certain combinations of oxidizers when used together in a slurry "exhibits a synergistically increased metal removal rate."

Additionally, while not proposed by the Examiner, Streinz at column 7 lines 17-26 teach adding acids, bases, and salts to a slurry, where nitric acid is included as a useful acid. Again, neither Streinz, nor Appellants with respect to claim 7, consider nitric acid to be an oxidizer.

As Streinz does not teach or suggest all the limitations of the claims, Appellants respectfully request that this rejection to independent claim 7 be reconsidered and removed. Further, Appellants request that the arguments against the rejection of claim 7 over Streinz be incorporated into the arguments of each of the remaining dependent claims.

B. With respect to Claim 10

Claim 10 stands rejected as being anticipated by Steintz. Claim 10 recites a slurry having an abrasive, wherein "the slurry further comprises a polyelectrolyte in an amount sufficient to encourage the abrasive particles to repel the surface to be polished." The recitation of claim 10 is contrasted with the recitation of claim 9, which recites a polyelectrolyte being present in an amount such that particles repel one another. The recitation of claim 9 relates to slurry stability and requires sufficient polyelectrolyte such that abrasive particles do not agglomerate and settle.

Streinz describes the use of compounds to

> "stabilize a polishing slurry containing an oxidizing agent against settling, flocculation and decomposition of the oxidizing agent" that include "surfactants, polymeric stabilizers or other surface active dispersing agents," and that "the addition of a surfactant may be useful to improve the within-wafer-non-uniformity (WIWNU) of the wafers," wherein "the amount of an additive used, such as a surfactant, in the present invention should be sufficient to achieve effective stearic *(sp)* stabilization of the slurry and will typically vary depending on the particular surfactant selected and the nature of the surface of the metal oxide abrasive."

See Streinz, column 7, line 54 to column 8, line 4. This disclosure of Streinz is similar to the recitation of claim 9, in that it relates to providing sufficient polymeric stabilizers to guard against settling and to provide effective steric stabilization of the slurry." Strentz discloses an immensely broad range of additives that includes from 0.001% to 10%. *See* Streinz, column 8, lines 7-9. Such a range encompasses all practical ranges of compounds, and extends well into impractical values. However, Streinz groups surfactants, polymeric stabilizers, and dispersing agents into his list of additives. Streinz disclosure does not teach or suggest, however, incorporating an amount of polyelectrolyte such that the particles are repelled from the substrate surface, as recited in claim 10. The amount of polyelectrolyte needed in claim 9 (and by Streinz) depends on the abrasive characteristics and on the polyelectrolyte. The amount of polyelectrolyte needed in claim 10 depends on the substrate surface as well as the abrasive characteristics and on the polyelectrolyte.

As Streinz does not teach or suggest all the limitations of the claims, Appellants respectfully request that this rejection to dependent claim 10 be reconsidered and removed.

C. With respect to Claim 11

Claim 11 stands rejected as being anticipated by Steintz. Claim 11 recites wherein the first oxidizer comprises ammonium persulfate and the second oxidizer comprises a peroxymonosulfate compound. Ammonium persulfate is $(NH_4)_2S_2O_8$, which is sometimes incorrectly simplified to read $(NH_4)SO_4$. The acid form of peroxymonosulfate, Caro's acid, is H_2SO_5. *See* the specification, page 18, lines 5-6.

Streinz does teach the use of persulfates, in that this term is used in the laundry list of useful oxidizers, specifically at column 4, line 3.

Appellants can not find, and the Examiner has not shown, where Streinz mentions peroxymonosulfate, much less a slurry having both persulfate and peroxymonosulfate. The Examiner points to Streinz at column 4 lines 1-13 and column 7 lines 17-40, "potassium salt." These sections of Streinz read as follows:

> potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof. Typically, the oxidizing agent is present in the CMP slurry in an amount sufficient to ensure rapid oxidation of the metal layer while balancing the mechanical and chemical polishing components of the slurry. The oxidizing agent is typically present in the final CMP slurry in a concentration of from about 0.5% to 15% by weight, and preferably in a range between about 1% to about 7% by weight depending upon the particular oxidizing agent chosen.

and

> Other well known polishing slurry additives may be incorporated into the chemical mechanical polishing slurry of this invention. One type of optional additives are inorganic acids and/or salts thereof which may be added to the polishing slurry to further improve or enhance the polishing rate of the barrier layers in the wafer, such as titanium and tantalum. Useful inorganic additives include sulfuric acid, phosphoric acid, nitric acid, ammonium salts, potassium salts, sodium salts or other cationic salts of sulfates and phosphates. A wide range of conventional organic acids, salts of organic acids, and mixtures thereof may be included in the CMP slurry of the present invention to enhance the selectivity to oxide polishing rate, such as monofunctional acids, difunctional acids, hydroxyl/carboxylate acids, chelating, non-chelating acids, and their salts. Preferably, the organic acid is selected from the group of acetic

> acid, adipic acid, butyric acid, capric acid, caproic acid, caprylic acid, citric acid, glutaric acid, glycolic acid, formic acid, fumaric acid, lactic acid, lauric acid, malic acid, maleic acid, malonic acid, myristic acid, oxalic acid, palmitic acid, phthalic acid, propionic acid, pyruvic acid, stearic acid, succinic acid, tartaric acid, valeric acid and derivatives, including salts thereof.

It is clear that Streinz does not teach a peroxymonosulfate compound, either in the above text or anywhere in the disclosure. The Examine suggests the term "potassium salts" anticipates a peroxymonosulfate compound because the peroxymonosulfate mixture used in Appellants own example, described on page 18 lines 9-10, happened to be the potassium salt of peroxymonosulfate. As Streinz does not teach or suggest all the limitations of the claims, Appellants respectfully request that this rejection to dependent claim 11 be reconsidered and removed.

D. With respect to Claim 12

Claim 12 recites "the first oxidizer comprises hydroxylamine nitrate and the second oxidizer comprises hydroxylamine." This claim stands rejected as being anticipated by Streinz. Appellants note that claim 12 is very similar to claims 16 and 17, which recite hydroxylamine nitrate and from about 0.005% to about 0.36% by weight hydroxylamine. Claims 16 and 17 stand rejected as being obvious over Streinz. The issue with claims 16 and 17 is support in the specification, and for this reason Applicants did not have these claims stand or fall together.

The laundry list of oxidizers that Streinz in column 3, line 59 to column 4, line 4, says can be used was reproduced above. Hydroxylamine and hydroxylamine salts are conspicuously absent from this list. Indeed, neither hydroxylamine nor hydroxylamine salts are mentioned in Streinz. The Examiner points to column 4 lines 1-13 and column 5 lines 40-55, "ammonium hydroxide." These sections of Streinz read as follows:

> … potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof. Typically, the oxidizing agent is present in the CMP slurry in an amount sufficient to ensure rapid oxidation of the metal layer while balancing the mechanical and chemical polishing components of the slurry. The oxidizing agent is typically present in the final CMP slurry in a concentration of from about 0.5% to 15% by weight, and preferably in a range between about 1% to about 7% by weight depending upon the particular oxidizing agent chosen.

and

> The CMP slurry pH can drop below 1.0 when fluoride containing acids are incorporated into the slurry. A CMP slurry having a pH less than about 1.0 is still useful. However, at pH's less than about 1.5, handling the CMP slurry safely becomes a concern. Therefore, it is preferred that the CMP slurries of this invention have pH's greater that about 1.5. To achieve a minimum pH of 1.5 or greater, an aqueous base such as potassium hydroxide, sodium hydroxide, ammonium hydroxide or the like may be added to the chemical mechanical polishing slurry to raise the slurry pH to greater than about 1.5 and preferably within the desired range of from about 1.5 to about 5.0.

The Examiner apparently is confusing Streinz's somewhat inarticulate disclosure of "ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides" with hydroxylamine or hydroxylamine salts. Ammonia has the formula NH_3 and ammonium hydroxide has the formula HN_4OH. The claim at issue recites hydroxylamine, a compound having the formula NH_2OH. The two compounds have vastly different properties. Hydroxylamine, "decomposes rapidly at room temperature, violently when heated, and detonates in flame-heated test tube. Ammonia, NH_3, can autoignite at 1204 degrees F, and is a moderate fire risk with explosive limits in air of 16 to 25%. *See* Hawley's Condensed Chemical Dictionary, Twelfth Edition, pages 622 and 62, attached to the amendment submitted October 14, 2004. Hydroxylamines are known reducing agents, and Appellants found that at certain pH ranges hydroxylamine acts as an oxidizer. Ammonia, ammonia salts, and quaternary ammonium salts do not have any oxidizing capacity.

Applicants point out that the specification describes using ammonium hydroxide in CMP slurries, but it is a complexer, not an oxidizer. *See* the specification, page 5, second full paragraph. Applicants also polished copper with an ammonium hydroxide solution, noting that if air or oxygen is added to the ammonium hydroxide slurry then copper etching rates can be measurable. *See* the specification, page 11, third and fourth full paragraphs. Ammonium salts are useful for polishing the oxide (oxide polishing, as opposed to metal polishing) as is taught in the specification, page 14, fourth full paragraph.

Additionally, Streinz does not teach or suggest use of any salts of hydroxylamine. Hydroxylamine salts are different oxidizers than hydroxylamine, because the salts are so tightly bound to the hydroxylamine that the oxidizing potential of the salt is markedly different than the oxidizing potential of hydroxylamine. As an indicator of its reactivity, while hydroxylamine can not be purchased nor safely handled unless it is diluted with an equal weight of water, hydroxylamine salts are routinely available as solids and/or 85% solutions. However, hydroxylamine is a special case. Merely adding an acid or base to hydroxylamine in a polishing solution will only form a solution having the salts and hydroxylamine, but will not form the salt of hydroxylamine. To form the hydroxylamine salts it is necessary to reach pH values outside the range normally encountered in slurries, for example, to above pH 11 to form the phosphate salt of hydroxylamine.

As Streinz does not teach or suggest all the limitations of the claims, Appellants respectfully request that this rejection to dependent claim 12 be reconsidered and removed. Additionally, Appellants respectfully request that this argument be incorporated by reference into the arguments for claims 13, 15-17, 19-20, 50-52, and 56, each of which recites hydroxylamine.

E. With respect to Claim 13

Claim 13 recites that the first oxidizer comprises from about 0.5% to about 10% hydroxylamine nitrate. Applicants do not specify the identity of the second oxidizer in claim 13. Claim 13 stands rejected as being anticipated by Streinz. Support for the concentration range was presented in Section 5. Streinz does not teach or suggest use of any salts of hydroxylamine in his polishing slurries. As Streinz does not teach or suggest all the limitations of the claims, Appellants respectfully request that this rejection to dependent claim 12 be reconsidered and removed.

F. With respect to Claim 15

Claim 15 recites the second oxidizer comprises from about 1% to about 10% hydroxylamine. Applicants do not specify the identity of the first oxidizer in claim 13. There is no distinction between the first and second oxidizers, other than that they be different. Streinz does not teach or suggest use of any salts of hydroxylamine in his polishing slurries. As Streinz does not teach or suggest all the limitations of the claims, Appellants respectfully request that this rejection to dependent claim 12 be reconsidered and removed.

G. With respect to Claims 18 and 23

Claims 18 and 23 recite the slurry comprises ammonium persulfate and periodic acid, in particular 0.5% to 2% of periodic acid. Claim 23 stands rejected as being anticipated by Streinz, and claim 18 stands rejected as being obvious over Streinz. This claim is differentiable over earlier claims in that both of the oxidizers recited in claims 18 and 23 are present in the laundry list of Streinz. Appellants concede that evidence of secondary considerations, such as unexpected results or commercial success, is irrelevant to 35 U.S.C. 102 rejections. Nevertheless, Applicants maintain that the broad disclosure of Streinz does not qualify as an anticipatory document, but rather is at most a reference relating to the question of obviousness. Streinz does not teach that a combination of two oxidizers may give synergy with metal removal rates. Streinz merely provides a broad list of oxidizers and states that any or does not teach or suggest the unexpected results Applicants found, that is, that certain combinations of oxidizers gave synergystic metal removal rates.

This is because Appellants and the Examiner disagree about what the phrase "and mixtures thereof" in at column 4 line 4 of Streinz refers to. The punctuation (or lack thereof), and use of the phrase "such as" at column 3 line 62 and more importantly the inclusion of the phrase "and the like" at column 3 line 67 requires that the list in the disclosure of Streinz should be construed as follows:

> Suitable oxidizing agents are those that are compatible with fluoride containing additives including
>
> a) oxidizing metal salts,
> b) oxidizing metal complexes,
> c) nonmetallic oxidizing acids such as peracetic and periodic acids,
> d) iron salts such as nitrates, sulfates, EDTA, citrates, (and) potassium ferricyanide,
> e) hydrogen peroxide,
> f) potassium dichromate,
> g) potassium iodate,
> h) potassium bromate,
> i) vanadium trioxide and the like, (and)
> j) aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof.

The disclosure must be read for what it might teach, and the Examiner can not ignore punctuation (or lack thereof) to make the disclosure say more than it says. The list clearly groups oxidizers, as shown by the inclusion of oxidizing metal complexes group, followed by nonmetallic oxidizing acids group, then the iron salts group, then hydrogen peroxide.... The use of the term "and the like" in part (i) is a clear delimiter in the list. Further, the terms "sodium salts" potassium salts" and ammonium salts are nonsensical (they don't oxidize" unless they refer to the "peroxides, perchlorates..." at the end of this group. Finally, as there is no comma between "persulfates" and the phrase "and mixtures thereof", the disclosure must be construed to recite a last group which reads "aluminum salts ... or other cationic salts of peroxides, perchlorates ... or mixtures thereof." That is, the phrase "and mixtures thereof" must refer to the group of salts of oxidizers which begins with "aluminum salts" and ends with "and mixtures thereof." Therefore, the phrase "and mixtures thereof" in Streinz can not refer back to the "nonmetallic oxidizing acids such as peracetic and periodic acids." Reading the phrase "and mixtures thereof" to refer back to "nonmetallic oxidizing acids such as peracetic and periodic acids" would require ignoring the phrase "and the like", as well as adding punctuation (new matter) not present in the disclosure.

Applicants concede that the claims of Streinz recites a different list than is in the disclosure, in particular eliminating the term "and the like" and changing the last lines to read "sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, cationic salts of peroxides, cationic,*(er)* salts of chlorates, cationic salts of perchlorates, cationic salts of nitrates, cationic salts of permanganates, cationic salts of persulfates and mixtures thereof. Here, it is not even clear if the term "ammonium salts" refers to any ammonium salt (as if ammonium were an oxidizer) or to ammonium salts of peroxides. However, to the extent the claims contain new matter not in the specification as originally filed, it is not certain whether the claims of Streinz constitute prior art to the instant application.

Applicants surprisingly found that certain combinations of oxidizers gave synergy in metal removal rates. But none of these groups fall with the group "aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof." Applicants therefore respectfully ask that the rejection of claim 7 as being anticipated by Streinz be withdrawn.

As Streinz does not disclose all the limitations of the claim, or alternatively as Streinz in fact does not disclose mixtures of "nonmetallic oxidizing acids such as peracetic and periodic acids" with ammonium salts of persulfates, Appellants respectfully request that this rejection to dependent claims 18 and 23 be reconsidered and removed.

H. With respect to Claims 19 and 20

Claims 19-20 stand together. Claim 19 recites the slurry comprises hydrogen peroxide and hydroxylamine, and this claim stands as being anticipated by Streinz. Claim 20 recites the slurry comprises hydrogen peroxide and between 1% and 10% of hydroxylamine, and this claim stands as being obvious over Streinz.

With respect to claim 19, Streinz does not disclose, teach, or suggest hydroxylamine in any form. As Streinz does not disclose all the limitations of claim 19, Appellants respectfully request that this rejection to dependent claims 19 be reconsidered and removed.

Additionally, with the Examiner can not rely on the knowledge of one of ordinary skill in the art and suggest that one of ordinary skill in the art might know to include hydroxylamine or salts thereof into the list of Streinz, and then to suggest that said person of ordinary skill would then be motivated to further expand the use of the term "and mixtures thereof" beyond the apparent meaning in Streinz, and thereby by hindsight reconstruction create the invention of claim 20. First, the Examiner has not offered any reference pertaining to hydroxylamine. Second, the range of 1 to 10% of hydroxylamine recited in claim 20 has specific utility, as described at page 13 lines 23-28, to allow the hydroxylamine to be in the range where the zeta potential of the abrasive particles can be tuned.

I. With respect to Claims 21 and 58

Claims 21 and 58 stand or fall together, and each claim stands as being anticipated by Streinz. Claim 21 recites the first oxidizer comprises ammonium persulfate and the second oxidizer comprises potassium periodate. Claim 58 the first oxidizer is a persulfate and the second oxidizer is an IO4- salt. The Examiner cites Streinz at column 3 lines 55-67 and column 4 lines 1-5 for claim 21. These sections of Streinz read as follows:

> … tungsten, and various mixtures and combinations thereof by mechanically polishing the metals to remove the respective oxide layer. A wide range of oxidizing agents may be used in the CMP slurry of this invention. Suitable oxidizing agents are those that are compatible with fluoride containing additives including oxidizing metal salts, oxidizing metal complexes, nonmetallic oxidizing acids such as peracetic and periodic acids, iron salts such as nitrates, sulfates, EDTA, citrates, potassium ferricyanide, hydrogen peroxide, potassium dichromate, potassium iodate, potassium bromate, vanadium trioxide and the like, aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof. Typically, the oxidizing agent is present in the CMP slurry…

First, Streinz does not disclose any salt of a periodate. The only reference in Steinz relating to periodates is "nonmetallic oxidizing acids such as peracetic and periodic acids." Streinz discloses salts of certain oxidizers, in particular salts of peroxides, chlorates, perchlorates, nitrates, permanganates, and persulfates. Periodates are conspicuously absent from this second list. Streinz nowhere discloses a salt of periodic acid as being useful. As Streinz does not disclose all the limitations of claim 21, Appellants respectfully request that this rejection to dependent claim 21 be reconsidered and removed.

Claim 58 recites the first oxidizer is a persulfate and the second oxidizer is an IO_4^- salt. The Examiner cites the above sections of Streinz, and additionally recites column 5 lines 40-55 and column 7 lines 17-40. These sections read as follows:

> The CMP slurry pH can drop below 1.0 when fluoride containing acids are incorporated into the slurry. A CMP slurry having a pH less than about 1.0 is still useful. However, at pH's less than about 1.5, handling the CMP slurry safely becomes a concern. Therefore, it is preferred that the CMP slurries of this invention have pH's greater that about 1.5. To achieve a minimum pH of 1.5 or greater, an aqueous base such as potassium hydroxide, sodium hydroxide, ammonium hydroxide or the like may be added to the chemical mechanical polishing slurry to raise the slurry pH to greater than about 1.5 and preferably within the desired range of from about 1.5 to about 5.0. .... (and) Other well known polishing slurry additives may be incorporated into the chemical mechanical polishing slurry of this invention. One type of optional additives are inorganic acids and/or salts thereof which may be added to the polishing slurry to further improve or enhance the polishing rate of the barrier layers in the wafer, such as titanium and tantalum. Useful inorganic additives include sulfuric acid, phosphoric acid, nitric acid, ammonium salts, potassium salts, sodium salts or other cationic salts of sulfates and phosphates. A wide range of conventional organic acids, salts of organic acids, and mixtures thereof may be included in the CMP slurry of the present invention to enhance the selectivity to oxide polishing rate, such as monofunctional acids, difunctional acids, hydroxyl/carboxylate acids, chelating, non-chelating acids, and their salts. Preferably, the organic acid is selected from the group of acetic acid, adipic acid, butyric acid, capric acid, caproic acid, caprylic acid, citric acid, glutaric acid, glycolic acid, formic acid, fumaric acid, lactic acid, lauric acid, malic acid, maleic acid, malonic acid, myristic acid, oxalic acid, palmitic acid, phthalic acid, propionic acid, pyruvic acid, stearic acid, succinic acid, tartaric acid, valeric acid and derivatives, including salts thereof.

The Examiner's logic is unclear. The Examiner seems to suggest that someone might be tempted to form a slurry of periodic acid and a persulfate, and then to see that the pH is below 1, and then to add base to obtain salts thereof. This is clearly hindsight reconstruction, which additionally ignores the teaching of Streinz regarding the nonmetallic acid periodic acid as being useful, but that periodates are conspicuously absent from the list of oxidizer salts that might be useful. *See* the argument pertaining to claim 7, which is incorporated here by reference. As Streinz does not disclose all the limitations of claim 58, Appellants respectfully request that this rejection to dependent claim 58 be reconsidered and removed.

J. With respect to Claims 22 and 57

Claim 22 and 57 stand together, and both stand rejected as being anticipated by Streinz. Claim 22 recites the first oxidizer comprises ammonium persulfate and the second oxidizer comprises potassium iodate. Claim 57 recites that the first oxidizer is a persulfate and the second oxidizer is an IO_3^- salt. Here, both of the recited oxidizers are present in the laundry list of Streinz. For these claims, Appellants are relying on the arguments recited with respect to claims 7, 18, and 23, which are incorporated here by reference. In particular, these arguments are 1) that Streinz does not anticipate the claim because Streinz does not teach all the limitations of the claim in that Streinz does not teach a synergistic increase in removal rate, and 2) Streinz does not teach the claim limitation reciting a slurry having potassium iodate with ammonium persulfate because the phrase "or mixtures thereof" in column 4 line 4 refers to the group "aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, persulfates and mixtures thereof" and does not include potassium iodate. As Streinz does not disclose all the limitations of claims 22 and 57, Appellants respectfully request that this rejection to dependent claims 22 and 57 be reconsidered and removed.

K. With respect to Claim 53

Claims 53 stands rejected as being anticipated by Streinz. Claim 53 recites that the first oxidizer is an indirect source of hydrogen peroxide. The Examiner cites Streinz at column 3 lines 55-67 to support his case. This section of Streinz reads as follows.

> … tungsten, and various mixtures and combinations thereof by mechanically polishing the metals to remove the respective oxide layer. A wide range of oxidizing agents may be used in the CMP slurry of this invention. Suitable oxidizing agents are those that are compatible with fluoride containing additives including oxidizing metal salts, oxidizing metal complexes, nonmetallic oxidizing acids such as peracetic and periodic acids, iron salts such as nitrates, sulfates, EDTA, citrates, potassium ferricyanide, hydrogen peroxide, potassium dichromate, potassium iodate, potassium bromate, vanadium trioxide and the like, aluminum salts, sodium salts, …

The Examiner contends that the above language teaches a slurry having first and second oxidizers, wherein the composition on polishing a metal gives synergistic increase in the metal removal rate, and wherein one of the oxidizers is an indirect source of hydrogen peroxide. Appellants can see hydrogen peroxide recited in that section, but nothing relating to an indirect source of hydrogen peroxide. The specification teaches that percarbonate (sodium carbonate peroxyhydrate) and perborate are good indirect sources of hydrogen peroxide. *See* the specification, line 19-31. Neither of these compounds are taught or suggested in Streinz, either in the section cited by the Examiner or anywhere else. As Streinz does not disclose all the limitations of claim 53, Appellants respectfully request that this rejection to dependent claim 53 be reconsidered and removed.

L. With respect to Claim 54

Claims 54 stands rejected as being anticipated by Streinz. Claim 54 recites the first oxidizer is a urea hydrogen peroxide complex. Claim 54 erroneously depends from claim 53, where it should depend from claim 7. Should claim 54 be allowable, Appellants will submit an amendment asking that the dependency of the claim be changed to depend directly from claim 7, without incorporating the limitations of claim 53.

The Examiner cites a number of sections of Streinz for teaching the first oxidizer is a urea hydrogen peroxide, in particular column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40. Appellants can not find urea hydrogen peroxide in the cited sections. A word search of Streinz does not turn up the word urea. Synonyms for urea hydrogen peroxide include "urea peroxide," percarbamide peroxide," and "carbamide peroxide." These words also can not be found in Streinz. The closest recital Appellants can find in Strienz is at column 4 lines 1-4 which recite "ammonium salts ... or other cationic salts of peroxides." Applicants are not aware of any ammonium salts of hydrogen peroxide. Ammonium (NH4OH) has a different structure than urea ($CO(NH_2)_2$. Applicants can not see Strienz teaching or suggesting urea hydrogen peroxide, alone or in a slurry with another oxidizer, much less explicitly teaching this embodiment as required by the anticipation rejection. As Streinz does not disclose all the limitations of claim 54, Appellants respectfully request that this rejection to dependent claim 54 be reconsidered and removed.

M. With respect to Claim 55

Claims 55 stands rejected as being anticipated by Streinz, with the Examiner in particular citing column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40. Claim 55 recites the first oxidizer is a percarbonate. As previously stated, Streinz does not teach a percarbonate. Steintz does teach "nonmetallic oxidizing acids such as peracetic and periodic acids." Percarbonate (e.g., a salt of carbonate peroxyhydrate, as described in the specification at page 19, lines 29-31) is not mentioned. Streinz does recite "aluminum salts, sodium salts, potassium salts, ammonium salts, quaternary ammonium salts, phosphonium salts, or other cationic salts of peroxides." This clearly does not anticipate the recited percarbonate, and additionally can not be said to even make the claim obvious. Streinz teaches a number of acids and bases to adjust the pH of a slurry, but a carbonate salt is not included. Additionally, Streinz teaches a "cationic salt". A cation has a plus charge, and examples include quaternary ammonium, sodium, aluminum, and potassium salts. But with a percarbonate, the hydrogen peroxide is bound to the anion, that is, it forms a carbonate-peroxide complex. Streinz would have described this as an anionic salt of a peroxide, a phrase which is not in Streinz because Streinz had not thought of this embodiment. As Streinz does not disclose all the limitations of claim 55, Appellants respectfully request that this rejection to dependent claim 55 be reconsidered and removed.

N. With respect to Claim 56

Claims 56 stands rejected as being anticipated by Streinz, with the Examiner in particular citing column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40. Claim 56 depends from claim 53, and therefore recites the composition of claim 7 wherein the first oxidizer is an indirect source of hydrogen peroxide, and wherein the second oxidizer is a hydroxylamine. As argued with respect to claim 12, Streinz does not suggest or teach any hydroxylamine oxidizer (hydroxylamine or salt thereof). As argued with respect to claim 53, Streinz does not suggest or teach an indirect source of peroxide. As Streinz does not disclose all the limitations of claim 56, Appellants respectfully request that this rejection to dependent claim 56 be reconsidered and removed.

O. With respect to Claim 59

Claims 59 stands as being anticipated by Streinz. Claim 59 recites the first oxidizer is a persulfate and the second oxidizer is an $H_4IO_6^{-2}$ salt. The Examiner points to the same above-reproduced sections of Streinz - column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40 - cited against claim 58 to support his prima facie case. The arguments presented with respect to claims 21 and 58 in the immediately preceding section are incorporated herein by reference. Further, Streinz does not disclose any $H_4IO_6^{-2}$ salt. The formula of a salt of a periodate will depend on the metal ion. Lithium salts can form a $H_4IO_6^{-2}$ salt, but Streinz does not disclose lithium. Streinz discloses potassium salts, which make the IO_4^- salt. Appellants noted that certain periodates (such as lithium) exist in a hydrated $H_4IO_6^{-2}$ form while some periodates (such as potassium) exist in the IO_4^- form. *See* the specification, page 24, lines 19-21. Applicants found "in mixtures of K and Li periodates with (ammonium persulfate), systems with higher proportions of Li:K provide higher W removal rates." *See* the specification, page 24, lines 25-27. None of this is taught or suggested by Streinz. As Streinz does not disclose all the limitations of claim 59, Appellants respectfully request that this rejection to dependent claim 59 be reconsidered and removed.

P. With respect to Claim 60

Claims 60 stands as being anticipated by Streinz, with the Examiner again in particular citing column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40. Claim 60 recites at least one oxidizer is selected to not contribute to mobile ion contamination. Appellants believe the disclosure in Streinz at column 4 lines 50-53 is more pertinent than the sections cited. Streinz at column 4 lines 50-53 states "Sodium is recognized as a potential thin-layer film contaminant. Thus, the use of NaF in chemical mechanical polishing slurries is preferably avoided in applications where sodium contamination is undesirable." Streinz therefore recognized the importance of avoiding metal ions when polishing semiconductor substrates, yet he recommended the use of ammonium salts only as it pertained to the fluoride additive. Streinz clearly did not teach or suggest reducing mobile ion contamination via the selection of oxidizers. Of the many, many oxidizers Streinz recommended, only "nonmetallic oxidizing acids such as peracetic and periodic acids," hydrogen peroxide, and "ammonium salts, quaternary ammonium salts, or phosphonium salts of peroxides, chlorates, perchlorates, nitrates, and persulfates qualify as not contributing to mobile ion contamination. In contrast, Streinz recommends oxidizing metal salts, oxidizing metal complexes, iron salts such as nitrates, sulfates, EDTA, citrates, potassium ferricyanide, potassium dichromate, potassium iodate, potassium bromate, vanadium trioxide and the like, aluminum salts, sodium salts, potassium salts, or other cationic salts of peroxides, chlorates, perchlorates, nitrates, permanganates, or persulfates. Each of these contributes to mobile ion contamination.

Strienz can therefore not be fairly held to teach the limitations of claim 60. As Streinz does not disclose all the limitations of claim 60, Appellants respectfully request that this rejection to dependent claim 60 be reconsidered and removed.

Q. With respect to Claim 61

Claims 61 stands as being anticipated by Streinz, with the Examiner again in particular citing column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40. Claim 61 recites that the slurry does not stain polishing equipment. This is not taught anywhere in Streinz. Further, this claim is not an inherent property of the slurries taught by Streinz. The specification at page 4 lines 18-24 teaches that a ferric nitrate solution and potassium iodate system can stain equipment. Such disclosure is not taught or suggested by Streinz, and all of the Examples in Streinz used the ferric nitrate system that is most responsible for staining equipment. Strienz can therefore not be fairly held to teach the limitations of claim 61. As Streinz does not disclose all the limitations of claim 61, Appellants respectfully request that this rejection to dependent claim 61 be reconsidered and removed.

R. With respect to Claim 62

Claims 62 stands as being anticipated by Streinz, with the Examiner again in particular citing column 3 line 57 to column 4 line 5, column 5 lines 40-55, and column 7 lines 17-40. Claim 62 recites that neither the first nor the second oxidizers are nitric acid. As stated with respect to claim 7, this limitation is believed to be inherent in independent claim 7, and claim 62 is not believed to add a new limitation to independent claim 7. Should the Board disagree with Appellants arguments pertaining to claim 7, however, Appellants would then argue that claim 62 is patentable. The specification at page 4 lines 12-17 teach the problems with nitric acid (if present in enough of a concentration to be considered to be an "oxidizer." Streinz teaches that a pH below 1 is not preferred. Streinz does teach that, to his slurry having an oxidizer and a fluoride-containing additive, that an inorganic acid or salt thereof can be included to enhance the polishing rate. *See* Streinz, column 7, lines 19-26. It has long been known in the art that polishing rates are pH dependent, and also that polishing rates can increase if salts are added to the slurry. However, the inorganic acids and salts thereof, which include nitric acid, are not oxidizers. As Streinz does not disclose all the limitations of claim 62, Appellants respectfully request that this rejection to dependent claim 62 be reconsidered and removed.

Rejections under 35 U.S.C. 103

The following claims stand as being rejected under 35 U.S.C. 103 over Streinz.

S. With respect to Claims 50-52

Claims 50-52 stand together, and are rejected as being obvious over Streinz. Claims 50-52 recite that wherein the polishing slurry comprises about 0.005%, 0.04%, and 0.36% by weight hydroxylamine. The argument presented with respect to claim 12, that Streinz does not disclose any hydroxylamines, is incorporated here by reference. In addition, Streinz at column 4 states the "oxidizing agent is typically present in the final CMP slurry in a concentration of from about 0.5% to 15% by weight, and preferably in a range between about 1% to about 7% by weight." Streinz does not disclose the oxidizer recited in any of claims 50-52. Streinz does not disclose the concentration range recited in any of claims 50-52. As Streinz does not disclose all the limitations of claims 50-52, Appellants respectfully request that this rejection to dependent claims 50-52 be reconsidered and removed.

T. With respect to Claims 16 and 17

Claims 16 and 17 stand rejected as being obvious over Streinz. Claim 16 recites the first oxidizer comprises hydroxylamine nitrate and the second oxidizer comprises from about 0.005% to about 0.36% by weight hydroxylamine. Claim 17 recites the amount of hydroxylamine is 0.04%. The support for this claim was described in Section 5. This claim recites the experiment described in detail on page 27 lines 20-24 where 10% hydroxylamine nitrate in water was titrated to pH values of 3, 4, and 5 with hydroxylamine. Applicants had previously stated that the disclosure of the pH provided one of ordinary skill in the art the amount of hydroxylamine, which could be estimated by equations or which could be readily determined experimentally by one of ordinary skill in the art by routine analysis. A pH of 3 required 0.005% hydroxylamine, a pH of 4 required 0.04% hydroxylamine, and a pH of 5 required 0.36% hydroxylamine.

The arguments pertaining to claim 12, that Streinz does not disclose any hydroxylamine oxidizer, are incorporated herein by reference. Additionally, Streinz teaches that the concentration of oxidizers is 0.5% to 15%, preferably 1% to 7%. *See* Streinz, column 4, lines 8-13. The recited claims teach concentrations that are 0.36% or less, though Appellants concede this is the concentration of one of two oxidizers in the slurry, and the concentration of the other oxidizer required by the claim is not recited.

Nevertheless, Streinz does not teach or suggest a combination of oxidizers giving synergistic metal removal rates, and does not teach or suggest hydroxylamine as an oxidizer useful in a slurry, and does not teach or suggest that such small quantities of oxidizer might be useful. As Streinz does not disclose all the limitations of claims 16-17, Appellants respectfully request that this rejection to dependent claims 50-52 be reconsidered and removed.

In view of the foregoing, Appellant respectfully requests the reversal of the Examiner's rejections and allowance of the pending claims. A fee authorization sheet is submitted herewith, as is a request for a one month extension of time and a fee authorization therefore. However, if there are any outstanding fees due in connection with maintaining this case and with the filing of this Appeal Brief, please charge the fees to our Deposit Account No. 50-0310.

Respectfully submitted,

Date: July 13, 2005

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9. Appendix

1-6 (cancelled).

7. (Previously Presented) A method of chemically mechanically polishing a substrate, said method comprising:

providing a semiconductor wafer substrate comprising a surface having a metal to be polished; and

contacting the surface with a polishing slurry comprising a first oxidizer and a second oxidizer, wherein the second oxidizer is different than the first oxidizer, and the slurry comprising the first and second oxidizers exhibits a synergistically increased metal removal rate.

8. (Previously Presented) The method of claim 7, wherein the slurry further comprises abrasive particles.

9. (Previously Presented) The method of claim 8, wherein the slurry further comprises a polyelectrolyte in an amount sufficient to encourage the abrasive particles to repel one another.

10. (Previously Presented) The method of claim 8, wherein the slurry further comprises a polyelectrolyte in an amount sufficient to encourage the abrasive particles to repel the surface to be polished.

11. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises ammonium persulfate and the second oxidizer comprises a peroxymonosulfate compound.

12. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises hydroxylamine nitrate and the second oxidizer comprises hydroxylamine.

13. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises from about 0.5% to about 10% hydroxylamine nitrate.

14. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises from about 2% to about 10% hydroxylamine nitrate.

15. (Previously Presented) The method of claim 7, wherein the second oxidizer comprises from about 1% to about 10% hydroxylamine.

16. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises hydroxylamine nitrate and the second oxidizer comprises from about 0.005% to about 0.36% by weight hydroxylamine.

17. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises hydroxylamine nitrate and the second oxidizer comprises about 0.04% by weight hydroxylamine.

18. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises ammonium persulfate and the second oxidizer comprises from about 0.5% to about 2% periodic acid.

19. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises hydrogen peroxide and the second oxidizer comprises hydroxylamine.

20. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises hydrogen peroxide and the second oxidizer comprises from about 1% to about 10% hydroxylamine.

21. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises ammonium persulfate and the second oxidizer comprises potassium periodate.

22. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises ammonium persulfate and the second oxidizer comprises potassium iodate.

23. (Previously Presented) The method of claim 7, wherein the first oxidizer comprises ammonium persulfate and the second oxidizer comprises periodic acid.

24 to 49 (Cancelled).

50. (Previously Presented) The method of claim 7, wherein the polishing slurry comprises about 0.005% by weight hydroxylamine.

51. (Previously Presented) The method of claim 7, wherein the polishing slurry comprises about 0.04% by weight hydroxylamine.

52. (Previously Presented) The method of claim 7, wherein the polishing slurry comprises about 0.36% by weight hydroxylamine.

53. (Previously Presented) The method of claim 7, wherein the first oxidizer is an indirect source of hydrogen peroxide.

54. (Previously Presented) The method of claim 53, wherein the first oxidizer is a urea hydrogen peroxide complex.

55. (Previously Presented) The method of claim 53, wherein the first oxidizer is a percarbonate.

56. (Previously Presented) The method of claim 53, wherein the second oxidizer is a hydroxylamine.

57. (Previously Presented) The method of claim 7, wherein the first oxidizer is a persulfate and the second oxidizer is an IO_3^- salt.

58. (Previously Presented) The method of claim 7, wherein the first oxidizer is a persulfate and the second oxidizer is an IO_4^- salt.

59. (Previously Presented) The method of claim 7, wherein the first oxidizer is a persulfate and the second oxidizer is an $H_4IO_6^{-2}$ salt.

60. (Previously Presented) The method of claim 7, wherein at least one oxidizer is selected to not contribute to mobile ion contamination.

61. (Previously Presented) The method of claim 7, wherein the slurry does not stain polishing equipment.

62. (Previously Presented) The method of claim 7, wherein neither the first nor the second oxidizers are nitric acid.